

CLAIMS

What is claimed is:

1. A pump apparatus comprising:
 - a housing having a bore formed therethrough;
 - a piston disposed within said bore for reciprocal movement therein;
 - an annular seal disposed around said piston for reciprocal movement thereon, said piston having at least one passageway formed therein, said passageway, said piston, and said annular seal cooperating to form a check valve assembly, said check valve assembly dividing said bore into an inlet chamber and a pumping chamber, said annular seal being moveable to a first position relative to said piston in which said check valve assembly is in a flow-through position to fill said pump chamber with fluid from said inlet chamber during a fluid inlet stroke, said annular seal being moveable to a second position relative to said piston in which said check valve assembly is closed to pressurize the fluid within the pumping chamber during a pumping stroke;
 - a fluid inlet communicably connected to said inlet chamber and adapted to supply said inlet chamber with fluid; and
 - a fluid outlet communicably connected to said pumping chamber and adapted to release pressurized fluid from said pumping chamber.
2. The pump apparatus of Claim 1, wherein said piston has a longitudinal axis A and said piston comprises an inlet flange extending outwardly substantially perpendicular to said axis A, and wherein said at least one passageway in said piston comprises at least one longitudinally extending passageway formed in said inlet flange.
3. The pump apparatus of Claim 2, wherein said at least one passageway in said inlet flange is comprised of at least one longitudinally extending groove with semi-circular cross-section machined through said inlet flange.

4. The pump apparatus of Claim 3, wherein said at least one passageway in said inlet flange has an inner radius R_4 defined from said axis A that is larger than an inner radius of said seal defined from said axis A when said seal is centered about said axis A.

5. The pump apparatus of Claim 2, wherein said piston comprises a retaining flange, and wherein said at least one passageway in said piston further comprises at least one passageway formed in said retaining flange.

6. The pump apparatus of Claim 5, wherein said at least one passageway in said retaining flange is comprised of at least one groove with semi-circular cross-section machined through said retaining flange.

7. The pump apparatus of Claim 5, wherein said at least one passageway in said retaining flange has an inner radius R_3 defined from said axis A that is smaller than an inner radius of said seal defined from said axis A when said seal is centered about said axis A.

8. The pump apparatus of Claim 5, wherein said at least one passageway in said retaining flange and said at least one passageway in said inlet flange are communicably connected when said check valve assembly is in said flow-through position.

9. The pump apparatus of Claim 5, wherein an intermediate portion of said piston is disposed between said inlet flange and said retaining flange, said intermediate portion having at least one passageway formed therein, said at least one passageway in said piston further comprising said at least one passageway of said intermediate portion.

10. The pump apparatus of Claim 5, wherein said at least one passageway in said intermediate portion is comprised of at least one groove with semi-circular cross-section machined through said intermediate portion.

11. The pump apparatus of Claim 10, wherein said at least one passageway in said intermediate portion, said at least one passageway in said inlet flange, and said at least one passageway in said retaining flange are communicably connected when said check valve assembly is in said flow-through position.

12. The pump apparatus of Claim 10, wherein said at least one passageway in said intermediate portion has an outer radius R_1 defined from said axis A that is smaller than an inner radius R_4 of said at least one passageway in said inlet flange defined from said axis A.

13. The pump apparatus of Claim 5, wherein said seal includes at least one passageway formed therein, said at least one passageway in said seal and said at least one passageway in said piston are communicably connected when said check valve assembly is in said flow-through position.

14. The pump apparatus of Claim 13, wherein said at least one passageway in said seal has an outer radius defined from said axis A that is smaller than an inner radius R_4 of said at least one passageway in said inlet flange defined from said axis A.

15. A pump apparatus comprising:
- a housing having a bore formed therethrough;
 - a piston disposed within said bore for reciprocal movement therein;
 - an inlet flange, said inlet flange extending outwardly from said piston, said inlet flange having at least one passageway formed therein;
 - a retaining flange, said retaining flange extending outwardly from said piston, said retaining flange having at least one passageway formed therein;
 - an intermediate portion, said intermediate portion disposed between said inlet flange and said retaining flange, said intermediate portion having at least one passageway formed therein, said at least one passageway formed in said retaining flange being communicable with said at least one passageway formed in said intermediate portion of said piston;
 - an annular seal disposed around said intermediate portion of said piston, said seal slidably engaging the walls of said bore, said seal and said piston cooperating to form a check valve assembly, said bore being divided into an inlet chamber and a pumping chamber by said check valve assembly, said seal being moveable to a first position spaced apart from said inlet flange such that said check valve assembly is in a flow-through position to allow fluid to fill the pumping chamber, said seal being moveable to a second position sealing against said inlet flange such that said check valve assembly is in a closed position to allow fluid within said pumping chamber to be pressurized during movement of said piston in a pumping stroke;
 - a fluid inlet communicably connected to said inlet chamber and adapted to supply said inlet chamber with fluid; and
 - a fluid outlet communicably connected to said pumping chamber and adapted to release pressurized fluid from said pumping chamber.

16. The pump apparatus of Claim 15, wherein said at least one passageway in said inlet flange is comprised of at least one groove with semi-circular cross-section machined through said inlet flange.

17. The pump apparatus of Claim 15, wherein said at least one passageway in said retaining flange is at least one groove with semi-circular cross-section machined through said retaining flange.

18. The pump apparatus of Claim 15, wherein said annular seal is comprised of at least one of Polytetrafluoroethylene and Carbon Fiber.

19. The pump apparatus of Claim 15, wherein said check valve is in the closed position when said seal is seating on said inlet flange.

20. A piston and seal assembly for a vehicle braking system pump comprising:

a piston having an inlet flange, a retaining flange, and an intermediate portion disposed between said inlet flange and said retaining flange, said intermediate portion having at least one passageway formed therein, said inlet flange having at least one passageway formed therein, said retaining flange having at least one passageway formed therein, said at least one passageway formed in said retaining flange being communicable with said at least one passageway formed in said intermediate portion of said piston; and

an annular seal disposed around said intermediate portion of said piston, said seal and said piston cooperating to form a first check valve assembly, said seal being moveable to a first position relative to said inlet flange in which said first check valve assembly is in a flow-through position, said seal being moveable to a second position relative to said inlet flange in which said first check valve assembly is in a closed position.

21. A pump comprising:

a housing having a bore formed therethrough;

a piston disposed within said bore for reciprocal movement therein, said piston having an inlet flange, a retaining flange, and an intermediate portion disposed between said inlet flange and said retaining flange, said inlet flange having at least one passageway formed therein, said retaining flange having at least one passageway formed therein;

an annular seal disposed around said intermediate portion of said piston, said seal and said inlet flange cooperating to divide said bore into an inlet chamber and a pumping chamber;

a fluid inlet communicably connected to said inlet chamber, said seal being moveable to a first position relative to said inlet flange from said inlet chamber to permit fluid communication between said at least one passageway in said inlet flange and said at least one passageway in said retaining flange to allow fluid to fill said pumping chamber from said inlet chamber; and

a fluid outlet communicably connected to said pumping chamber to release pressurized fluid from said pumping chamber, said seal being moveable to a second position relative to said inlet flange in which said seal contacts said at least one passageway in said inlet flange to prevent fluid communication between said at least one passageway in said inlet flange and said at least one passageway in said retaining flange such that fluid within said pumping chamber is pressurized by movement of said piston during a pumping stroke and released through said fluid outlet.

22. A pump for a vehicle braking system comprising:

a housing having a bore formed therethrough;

a piston disposed within said bore for reciprocal movement therein, said piston defining a longitudinal axis, said piston having an inlet flange, a retaining flange, and an intermediate portion disposed between said inlet flange and said retaining flange, said inlet flange having a plurality of longitudinally extending grooves with semi-circular cross-section formed in a radially outer surface thereof, said intermediate portion having a plurality of longitudinally extending grooves with semi-circular cross-section formed in a radially outer surface thereof, said plurality of grooves in said intermediate portion being communicably connected to said plurality of grooves in said inlet flange, said retaining flange having a plurality of longitudinally extending grooves with semi-circular cross-section formed in a radially outer surface thereof, said piston being comprised of materials compatible with hydraulic brake fluid and adapted to withstand differential pressure consistent with use in a vehicle brake system;

an annular seal disposed around said intermediate portion of said piston, said seal and said intermediate portion cooperating to divide said bore into an inlet chamber and a pumping chamber, said seal being comprised of materials compatible with hydraulic brake fluid and adapted to withstand differential pressure consistent with use in a vehicle brake system;

a fluid inlet communicably connected to said inlet chamber to supply said inlet chamber with fluid, said seal being moveable to a first position relative to said inlet flange in which said plurality of grooves in said inlet flange are communicably connected to said pumping chamber, such that fluid from said inlet chamber fills said pumping chamber;

a fluid outlet communicably connected to said pumping chamber; and
a check valve disposed within said fluid outlet, said check valve being normally closed, said seal being moveable to a second position relative to said inlet flange in which said plurality of grooves in said inlet flange are prevented from communicating with said pumping chamber, such that the pressure of the

fluid within the pumping chamber builds until said check valve opens and pressurized fluid is released from said pumping chamber through said fluid outlet, said check valve being comprised of materials compatible with hydraulic brake fluid and adapted to withstand differential pressure consistent with use in a vehicle brake system;